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RESEARCH REPORT

LIMITATIONS OF THE CONVENTIONAL ROLE OF THE B-1B

IN THE EUROPEAN THEATER

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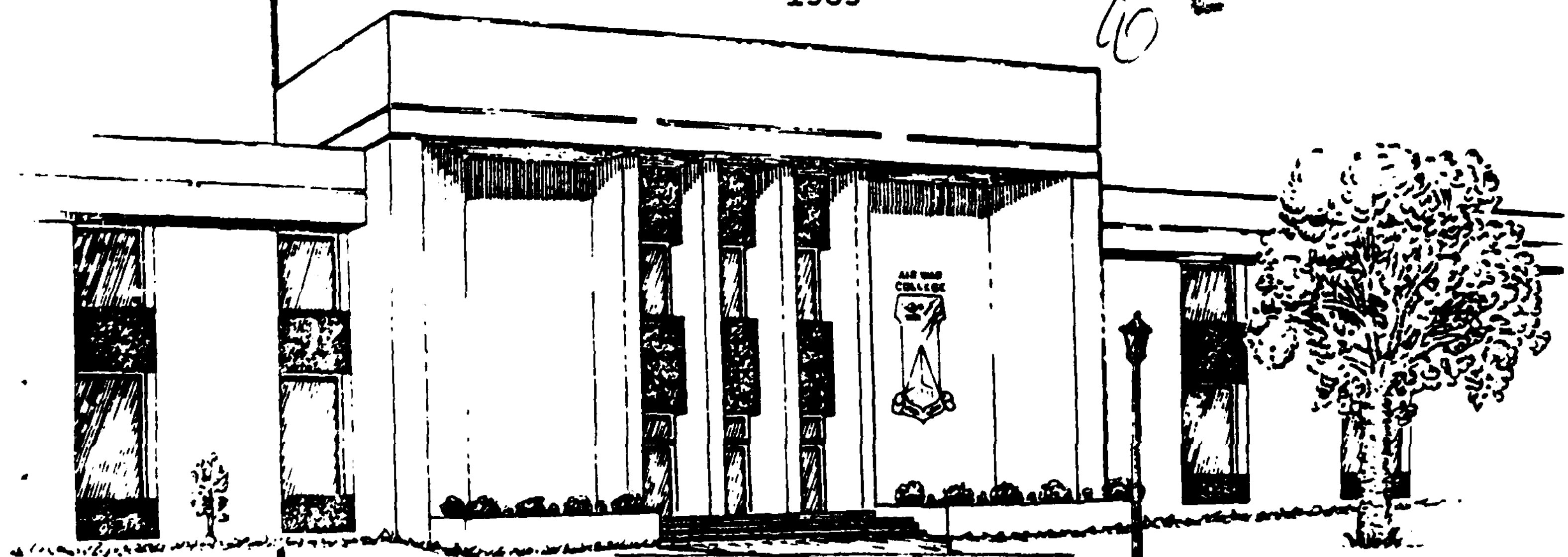

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LIMITATIONS OF THE CONVENTIONAL ROLE OF THE B-1B IN THE EUROPEAN THEATER

by

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A DEFENSE ANALYTICAL STUDY SUBMITTED TO THE FACULTY
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EXECUTIVE SUMMARY

TITLE: Limitations of the Conventional Role of the B-1B in the European Theater

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Outlines the capabilities of the Soviet defenses the B-1B would encounter on a European conventional mission and the characteristics of the B-1B that make it suited for this mission. A description of the conventional limitations of the weapon system follows with discussion of technological fixes. The lack of planning how the B-1B could best be exploited in a conventional role has led to developing an extremely limited conventional capability that is based on two weapons; the Mk 82, 500 pound gravity bomb, and the Mk 36, 500 pound mine. These are the only conventional munitions planned for the B-1B. The author suggests a long range perspective is lacking and for the B-1B to be viable in a conventional role new munitions must be developed.

BIOGRAPHICAL SKETCH

Lieutenant Colonel Paul J. Frichtl is a United States Air Force master navigator with over 600 hours of B-1B bomber flying experience. Paul has over 1000 hours flying in the FB-111A and 2500 hours in the B-52G of which 270 hours were flying combat in the Southeast Asia conflict. He has served in numerous bomber operations assignments with the most recent as Chief, B-1B Training Flight at the 96th Bomb Wing. Colonel Frichtl has completed Air Command and Staff College, is a distinguished graduate of National Security Management Course and has earned his Master of Science degree in Systems Management from University of Southern California. Lieutenant Colonel Frichtl is a graduate of Air War College, class of 1989.

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CHAPTER I
INTRODUCTION

The B-1B is Strategic Air Command's (SAC's) newest and finest bomber and is a vital member of the U.S. deterrent forces. Today it serves as a member of the nuclear TRIAD while it continues to be tested and equipped to perform a limited conventional mission.

The B-1B performs today's nuclear bomber penetration mission better than any other aircraft in the world. This ability to penetrate sophisticated defenses comes from a combination of design features to include: high speed at very low altitude using terrain following radar which minimizes exposure and reduces reaction time available to enemy defenses; a low radar cross section reducing radar detection ranges; high maneuverability and a versatile navigation system allowing the aircraft to maneuver to avoid threats; an electronic countermeasures (ECM) systems that detect threat radars directed at the aircraft and jam the selected threats that cannot be avoided, and stand-off nuclear short-range attack missiles to destroy ground based defense systems and attack the targets heavily defended by close-in defenses. (1:2-10) (See Appendix 1 for B-1B general characteristics)

Throughout the planning and initial acquisition processes SAC never intended the B-1B to have a conventional capability as the statement of need for the B-1B, and, for that matter, the original B-1A never included the requirement to deliver conventional munitions. (2:131) It was only after Senator John Glenn from Ohio persuasively lobbied against acquiring a nuclear only capable bomber, that the Air Force and Rockwell conceded to revise the B-1B aircraft requirements that added in a "demonstrated a conventional delivery capability". (2:132) This "added on" capability was key to the B-1B acquisition and in 1987 the B-1B demonstrated a limited conventional capability. However, it is doubtful as to whether the B-1B would be effective in a conventional role outfitted as it is today.

This paper highlights that there is only a limited role for the B-1B bomber in a European combined-arms conventional campaign

due to lack of conventional armament procured and planned for the B-1B. While unlike the slow, ungainly, and large B-52s, the speed, low radar cross section and other unique characteristics of the B-1Bs make it the most capable bomber for high threat missions. Additionally, many of the in-place threats a conventional bomber force would face today in protection of our country's vital national interests are formidable and are of increasing sophistication. (3:2) Thus the B-1B may be the weapon system of choice available to defeat the threat. However, to maximize the effectiveness of the B-1B, the Air Force, and SAC in particular, need to place greater emphasis on development of conventional weapons for this aircraft. Given the correct mix of weapons, this very effective bomber has the capability to strike deep behind enemy lines, and would allow the theater commander to disrupt, confuse and aid in the defeat of the enemy. The B-1B could be the conventional bomber of choice and will be the conventional bomber when all the B-52s are in the "boneyards." However, decisions must be made now to fund and develop a true "across-the-spectrum" conventional capability in the B-1B.

CHAPTER II
THE THREAT AND THE B-1B

If the B-1B were to be employed in the European theater, the Soviet air defense network it would encounter has become "the most formidable air defense network in the world," and is the greatest threat posed to penetrating aircraft. (4:3)

THE SOVIET THREAT CAPABILITY

The Soviet Union's air defenses rely primarily on thousands of fixed line-of-sight radars to find and track enemy aircraft. Such radars have several advantages: they can easily be supplied with electrical power, they are inexpensive to maintain, and they can detect high altitude aircraft at long distances. In addition, the data from many ground based radars can be communicated to a common processing facility, enabling the radars to operate collectively like a single radar with greater range. Such a radar network facilitates the coordination of fighters and provides more time for guiding them to intercept a penetrating bomber or cruise missile.

Fixed ground-based radars also have an important shortcomings. They are relatively easy to locate and once their position is established, a flight path outside their range can be plotted and flown. In addition, the range of a single ground-based radar against low-flying aircraft or cruise missiles is limited by the earth's curvature to about 20-50 nautical miles. Connecting radars into a network does not solve this problem unless the radars are close enough for their coverage to overlap.

The Soviet Union has improved its ground-based radar network by deploying mobile radars, which are harder to locate and, therefore, harder to attack. Because a penetrating bomber or cruise missile might not know where the radars are located (depending on how recently they have been moved), it might be impossible to plan a flight path to avoid them. Mobile radars, however, have the same limited ranges as fixed sites and there are so many potential gaps in

the Soviet radar network that plugging all of them with mobile radars would require a massive commitment of resources and personnel.

The primary way in which the Soviet Union remedies the shortcomings of its ground-based radars is to deploy large radars on aircraft. These aircraft, which are known as Airborne Warning and Control Systems (AWACS), monitor enemy penetrators and coordinate air defenses over a large area. The range of an AWACS is much greater than that of ground-based radars – over 200 miles to the horizon and over 400 miles to another aircraft at high altitude. When airborne, the AWACS cannot be targeted in advance since its precise location is unknown.

The first Soviet AWACS, the Moss, was relatively ineffective in tracking low-flying bombers and cruise missiles. The more recent Soviet AWACS, the Mainstay, is considered to be much more capable. (5:82) The Mainstays may patrol near the Soviet/Warsaw Pact borders to track approaching U.S. bombers, providing the greatest possible time to direct fighters to intercept them. Such patrols would force U.S. bombers to start flying at low altitudes earlier than planned in their flight, perhaps at distances of 300-400 miles from Soviet territory. The bombers would have to do this to minimize the distance at which the AWACS can detect them, most likely decreasing the bombers' range (low-altitude flight is less fuel efficient than high-altitude flight). The Soviet Union has so far deployed approximately a dozen Mainstay AWACS, and production is continuing. (5:82)

This massive radar network functions as the eyes of the Soviet Integrated Air Defense System (IADS) and is linked either directly or indirectly to Soviet fighter aircraft, Surface to Air Missile Systems (SAMS), and Anti-Aircraft Artillery (AAA). All of these weapon systems have in recent years increased in sophistication, lethality, and production at an alarming rate. (See Appendices 2 thru 4 for unclassified listing of Soviet SAMS and SAM capabilities.)

While the number of Soviet aircraft committed to strategic air

defense has remained at about 2,250 for the last several years, the interceptor force has nonetheless been improved significantly. Over the past eight years, the force has evolved from one consisting of 1950s and 1960s vintage aircraft to a rapidly modernizing inventory that includes over 160 MiG-31/FOXHOUND and 100 Su-27/FLANKER aircraft.(3:3) These new generation fighters have a true look-down/shoot-down capability – the capability to detect and destroy targets flying at low altitudes against a background of ground-clutter – using modern air-to-air missiles like the AA-9 and AA-10. These new-generation aircraft entering the force are replacing interceptors like the FIREBAR, FIDDLER, and FLAGON. The net effect is a force better able to threaten both US strategic bombers and US/NATO theater aircraft. (See Appendix 5 for an unclassified breakout of the Soviet fighter threat.)

The progress of the 1980s witnessed in Soviet aircraft development was paralleled with development in extremely sophisticated and lethal Soviet SAMS and AAA. The years of research and development efforts coupled with experiences primarily in Vietnam, Egypt, and Syria have borne fruit in the deployment of several new air defense weapon systems.

The Soviets have developed an entire family of SAM/AAAs that are predominantly mobile and are intended to offset what is seen to be the West's air superiority. (6:27) These systems are employed following two Soviet doctrinal principles of mass and mix that proved effectiveness in combat experience during the Middle East War in 1973 where the Israeli's suffered their greatest losses to date. (6:26) The density and depth of protection across the battlefield offered by the combined coverage of many Soviet weapons of different types, missiles and guns, that keep pace with rapidly moving ground units is awesome. However, there are problem areas and vulnerability in the operation of these tactical SAM/AAA units.

The potential for interruption of the Soviet IADS is a problem for them. This could arise from various sources: (a) the entire centralized effort coming "unglued" under the pressure of combat,

(b) Soviet commanders failing to push their air defense assets at the same tempo as that achieved by maneuver forces, (c) repeated strikes against air defense command and control infrastructure, and (d) the inherent difficulty in supplying air defense units with ammunition/missiles and spare parts during prolonged, fast moving offensive operations. A paramount weakness of the Soviet Tactical air defense system, as a whole, is its vulnerability to US/NATO standoff weapons. In fact, Soviet tacticians have also mentioned cruise missiles and seem to have a healthy respect for them. (6:27)

THE B-1B CAPABILITY

The ability of the B-1B to penetrate sophisticated defenses results from a set of carefully orchestrated design features. Among those features are: high speed low altitude, minimizing exposure and reducing the reaction time available for defenses; a very low altitude terrain following system, making maximum use of terrain masking; low radar cross section (RCS), reducing radar detection ranges; high maneuverability and a versatile navigation system, allowing the aircraft to maneuver to avoid threats; and a electronic countermeasures (ECM) systems that detect threat radars and jam selected threats. (7:7B) To understand full measure of each of these characteristics, each will be discussed.

The high speed capability allows the B-1B to cross the lethal range of a ground based threat much faster than other conventional bombers. When coupled with the terrain following capability, the time of exposure is reduced significantly. For example, a B-1B flying at 1000 feet above ground level (AGL) would be detected at 44.4 nautical miles (nm) whereas that same aircraft at 200 feet above ground would be detected at 22.9 nm, a difference of 21.5 nm. This distance equates to longer exposure time to the threat and can only be shortened by descending or speeding up. Converting detection range to time by using real-world, low-level cruise speeds of a B-52 versus a B-1B, some startling figures are arrived at. The B-52 flies low altitude at an average of 360 knots ground speed which equates an exposure time of 14 minutes 50 seconds at 1,000 feet

AGL and 7 minutes 40 seconds at 200 feet AGL. In comparison the B-1B cruising at .85 Mach which equates to an average 565 knots of ground speed traverses the same exposure window in 9 minutes 28 seconds at 1000 feet and 4 minutes 52 seconds at 200 feet. (See illustration in Appendix 6 for detail graphic.) Of note here is to recognize the benefits of the low and fast flight envelope in regards to increasing chances of survival, and it is precisely this flight environment in which the B-1B performs superbly, and automatically, using its automatic terrain following radar system.

Aircraft detection is not only a factor of range and altitude from any given ground-based radar site, it is also a factor of the aircraft radar cross section (RCS). This is the amount of radar energy returned or reflected back to a radar receiver from the aircraft after having been irradiated by a ground-based radar. The major factors that influence RCS are the size, shape, radar reflectivity, and radar absorbency of the aircraft of various aircraft components. The B-1B, being considerably smaller than say the B-52, presents a smaller head-on profile to a ground-based or air interceptor radar. The B-1B aircraft also incorporates a blended or smooth body concept void of the angular surfaces that reflect radar energy; it also features curved inlet ducts with radar absorbent baffles to prevent radar energy from reaching the fan blades on the engines and being reflected directly back to the transmitting radar site; and it is painted with absorptive paint. There also is Radar Absorbent Materials (RAM) placed throughout the aircraft which further reduces the RCS – by an order of magnitude to one-hundredth of the B-52's; this reduces the range at which a radar can detect a target by approximately two-thirds. (See Note 3 in Appendix 6 and associated reference)

Now to readdress the earlier detection figures in the previous paragraph. It can readily be seen that in reducing the detection range at 200 feet AGL by a factor of 2/3 or to 7.6 nm, a B-1B traveling at 565 knots now has a total exposure time of only 1 minute 36 seconds. (See Appendix 6) This, as all the computations, is worst case

and assumes the aircraft is flying directly at the ground threat which allows the greatest amount of time for the ground-based radar to acquire, lock-on, and fire either missiles or anti-aircraft artillery. If the aircrew is able to detect a ground-based threat or is aware of a threat by virtue of intelligence the threat can be skirted at the edge of detection range and detection time reduced even further.

Another feature of the B-1B is it's superb maneuverability. When coupled with a versatile precision navigation system, this aircraft can maneuver easily to avoid threats. By monitoring the threat situation display, the Defensive Systems Officer identifies the threats, either predicted or extemporaneous, in relation to aircraft and compares this with planned/projected route of flight. With this information he informs the pilot who can easily maneuver the aircaft to the best route of flight to avoid the ground-based threat.

Threats to the B-1B can be countered or reduced by the synergistic effects of speed, small radar cross section coupled with a ground hugging low altitude capability, and as I have just discussed, maneuverability. An additional defense to all types of radar emitting threats is electronic counter measures or ECM systems that detect threat radars directed at the aircraft and jam/confuse the selected threats that cannot be avoided. If there is a weakness in the defense of the B-1B, it is in this area. The ECM system, the ALQ-161, has failed to perform to baseline specifications by a wide margin. (8:42) There is limited ECM capability now and it is forecast the earliest to expect a fully operational ALQ-161 is 1991. (9:14) When this occurs the ECM system will be the most sophisticated on an operational bomber and one that will be able counter the threats through the 1990s.

The last B-1B unique feature to discuss is the weapons suspension system. All of the weapons racks for the B-1B are designed with the capability to be "clipped-in" place or inserted as an assembly with weapons in place. This means the weapons are mated

to the suspension rack and then the rack is "clipped-in" to the weapons bay. This allows for very rapid load time for weapons packages and is the current operational procedure in loading at all B-1B bases. This "clip-in" feature also allows for missions to be tailored at the last minute since maintenance is able to load a launcher full of weapons into a B-1B in approximately 50 minutes, if men and equipment are in place at the onset of the loading process. (10) There presently exists the capability then to rapidly change the mission by changing weapons load and, if the conditions warrant, to rapidly change the role from conventional to nuclear.

Several features that are unique to bombers in general need to be discussed at this point. The first is an all-weather, day or night, capability that can take the fight to the enemy. Currently, all SAC bombers can deliver ordinance in all weather; however, only the B-1B and the FB-111A have true low altitude - 500 feet AGL or lower - delivery capability in night and in weather since only those two aircraft have terrain-following radar. The B-52 would have to fly considerably higher and, as a result, would be considerably more vulnerable to the Soviet threats. Second, due to the large amount of weapons delivered, most bombers can have a definite psychological impact when used for deep strike. A surprise, deep attack against the enemy's second or third echelon forces will attrit forces before they can reach the battlefield and can have a demoralizing effect on enemy troops and, more importantly, the enemy commanders.

The synergistic interaction of all these factors is that which makes the B-1B a very credible weapon system. However, getting the aircraft to the battle does little good if it does not have a spectrum of effective weapons or weapons release capability to deliver various weapons on target. This forms the basis for the following discussion.

CHAPTER III
B-1B LIMITATIONS, EMPLOYMENT and TECHNOLOGICAL FIXES

The B-1B has several limitations that keep it from being used effectively and efficiently in a conventional role. There are weapons carriage limitations that were predicated by aircraft design, and aircraft weapons interface and release limitations.

CARRIAGE LIMITATIONS

The three weapons bays of the B-1B can be configured with the following: a rotary launcher in each bay that can hold eight nuclear gravity weapons or eight SRAM missiles each; a bay fuel tank in any or all bays; or a conventional weapons rack that is designed to hold only 28 Mk 82 bombs or Mk 36 mines on each rack. (11:1-37) In addition the forward and mid bay are separated by a movable bulkhead that when moved forward allow for an air launch cruise missile launcher in the now enlarged mid bay and a shortened version of a bay fuel tank in the forward bay. The rotary launchers, which are presently in the inventory, are designed to carry nuclear weapons only and the conventional racks now in acceptance testing for the B-1B will accommodate only the Mk 36 or Mk 82. (See following figure.)

Representative Bomber Conventional Weapons Carriage Capability [Present and Programmed]

	B-52G	FB-111A	B-1B		B 52G	FB-111A	B-1B
GP Bombs				Naval Sea Mines			
Mk 82	51	20	84	Mk 36	51	20	84
Mk 117	51	16		Mk 52	30		
Mk 84	18	4		Mk 60	18		
Cluster Bombs				Standoff Missiles			
CBU 52	51	20		AGM 84	8		
CBU 87(CEM)	30	20		AGM 136	30*	*Programmed	
CBU 89	30	20		Have Nap	3*		
(Source for figure 12:28)							

RELEASE LIMITATIONS

Both the rotary launcher and the conventional rack for the B-1B have to overcome the limitation imposed by the interrelated aerodynamic effects during high speed launch or weapons delivery from the bays. High speed, the aircrew's friend when traversing enemy territory, becomes an unseen barrier to be overcome when releasing weapons from the weapons bays. The airflow beneath the blended body of the B-1B creates a lifting moment to "hold" a weapon in the bay. To counter this airflow the B-1B weapons bay has a spoiler that extends in front of each bay to "spoil" the airflow. The spoiler, however, is not enough on its own to overcome the effects of this airflow and allow for safe weapons and airframe clearance while traveling at over 900 feet/second, so the weapons racks are equipped with explosive driven pistons that in effect eject the weapons out of the bay through the airflow. (11:1-37) Therefore, any weapons to be used on the B-1B must be designed to withstand the shock of being explosively hurled from the bay.

In addition, the release sequence for conventional gravity weapons, since they are being dropped in a string, must be timed to the microsecond for the three bays to achieve the accuracy and desired coverage. The releases must be alternated from one bay to another in order to achieve a short string and, in fact, the best string the B-1B can achieve is by dropping from only two of the weapons bays. Whether it be the forward and mid or the mid and aft bays, the shortest string that can safely be dropped is 56 Mk 82s within a 2,000 foot string. When releasing a full load of 84 weapons, the string length extends to 5,000 feet or roughly one nautical mile; in relation to aircraft speed that distance equates to 5 seconds of flight time. (13) This distance can be reduced by decreasing the interval between releases, but then aircraft safety is compromised by the inter-stores collisions that now will occur beneath the aircraft during the releases. The current SAC plan then is to carry the Mk 82s in the mid and aft bays only and fuel in the forward bay; this keeps the string length down to an unembarrassing 2,000 feet. (13)

As I mentioned earlier the only conventional weapons the B-1B can carry is Mk 82s and Mk 36s. I highlight again the fact these are the only two conventional weapons the B-1B can and is currently programmed to carry. (12:28) In 1985 all the various different types of Air Force and Navy conventional weapons currently carried or programmed to be carried on SAC aircraft were evaluated for the B-1B by the SAC staff and aircraft engineers. Recognizing that the Mk 82 / Mk 36 conventional racks would carry only those weapons, the study concentrated on weapons that could possibly fit on the present rotary launcher or required an entirely new suspension system. The staffers and engineers found none of the various weapons assessed would fit on the B-1B rotary launcher without extensive modification to either the weapon, the aircraft, or the launcher. (14:1)

Both the Mk 84, 2,000 pound gravity bomb and the Harpoon anti-shipping missile, for example, were attractive candidates. If they could be adapted they would greatly increase the respective hard target kill and maritime capability of the aircraft. In the case of the Mk 84 it was determined that three weapons could presently be carried unmodified in the bays (all three bays configured with a rotary launcher) provided the bombs were in the down position. To carry eight per launcher the bomb fins would have to be modified to fold, allowing clearance during rotation. These same fins would have to extend rapidly upon release of the weapon to ensure correct ballistic trajectory would be maintained for achieving weapon target. Providing this "folded fin" configuration could be engineered, a launcher rotation limitation now surfaces. There is no problem in dropping three Mk 84s in rapid sequence, but with the current launchers it would be up to a four second interval before the next weapon would be released. This limitation stems from the five seconds it takes for the rotary launcher to position the next station to be released to the down position and assuming that the launcher needs only to drive to the next sequential station. Assuming a 1/2 second interval or roughly 450 feet between the first three releases

followed by the time the first launcher is in position to release the next weapon, there would be a minimum 3,600 feet between the last impact of the first group of three, and the first impact of the subsequent releases. (15:19) Totally unacceptable! Thus Mk 84s and other gravities were not considered viable, but what about Harpoon's?

The addition of Harpoon anti-shipping missiles would give the B-1B a maritime role that would be unmatched. (16:39) Here again fitting the weapon on the rotary launcher required a fin modification to the weapon - missile fins in this case. As more data was collected the fin modification was the least of the problem areas to be encountered. It was discovered that Harpoons were not designed to be carried inverted and if carried on a rotary launcher, there would be a missile at the top of the launcher until at least four of the missiles were launched. (17:1) To be suspended inverted, the missile motor/engine would need redesign and further costly testing would be required to prove out the redesign functionality. Another problem exists, however: Presently when the Harpoon missiles are launched, a motor/engine intake cover must be physically removed via a lanyard that is attached to the cover and anchored to the missile suspension rack. In launching a Harpoon from the forward or mid bay of the B-1B, the lanyard(s) with the cover(s) would be exposed to the airflow beneath the aircraft and may be ripped loose and subsequently ingested by the underslung engines on the B-1B causing engine damage. (13) Thus the Harpoon missile, which on the surface appeared to be a viable weapon candidate, was dropped from the list of applicable conventional weapons.

All limitations inherent to the design of the B-1Bs weapons release systems, rotary launcher, the Mk 82/Mk 36 conventional carriage, or problems adapting all current inventory weapons to these systems were not covered in this brief discussion. However, the point I want the reader to clearly understand is the <u>only</u> conventional capability the B-1B has and is currently programmed to have is the carriage of Mk 82s or Mk 36s. There are no other conventional weapons that can easily or cheaply be modified for use on the

aircraft, and to date there are none being planned. (13) With this in mind how could we employ the B-1B in the European Theater today? Is there a mission where this weapon system is the obvious choice?

B-1B EUROPEAN EMPLOYMENT

Soviet doctrine is directed at achieving a quick battlefield victory through the use of mobile, rapid operations. (18:46) By using such tactics against NATO forces in contact, the Soviets hope not only for a quick decisive battle, but also for a quick, decisive war as well. Because of this doctrine, it is vital to the Soviets that the attacking echelons not be stopped or slowed by the defending NATO forces. The Soviets intend to accomplish this by concentrating preponderant combat power at the point(s) of the attack - so preponderant, in fact, that they will overcome the NATO defenses quickly. Therefore, from NATO's point of view, it is critical the forward edge of the battle area - the troops that are in contact - do not collapse before the retaliating offensive begins. (18:47)

To counter this Soviet approach, the U.S. and NATO have developed two doctrinal concepts: Airland Battle and Follow-on-Forces Attack (FOFA). (18:20) The success of both these approaches requires that military commanders have the capability to acquire and strike targets beyond the immediate battlefield. The primary difference between these two approaches, however, is the depth to which the Corps Commander needs to be able acquire and attack Soviet targets. Airland Battle is dependent upon acquiring targets up to 150-200 kilometers from the forward edge of the battle area (FEBA), while the FOFA concept necessitates acquiring and striking targets much deeper inside the Warsaw Pact territory. The basic objective is to delay, disrupt, and destroy forces that are deep, such as the Strategic reserves and those shallow forces not yet in contact, so that NATO defense forces can hold as far forward as possible.

What weapons system(s) does NATO have to accomplish this doctrine? The principal findings by the Office of Technology Assessment, chaired by Congressman Mo Udall, concluded in June of 1987

there was "no capability to attack very deep" and reliance must be on U.S. strategic bombers and yet-to-be developed conventional cruise missiles. (19:9)

This being the case, how could the B-1B be employed in a European scenario?

Considering the increasing and formidable threat, the unique capabilities of bombers in general, and the unclassified penetration capabilities of the B-1B I discussed earlier, there is capability, but with a corresponding great deal of risk in the employment of this aircraft. The employment capability is further limited, though, by being able to carry only two types of gravity weapons and both of these require overflight of the target area. In employing the B-1B with Mk 82 GP bombs, it would be generally effective against railyards, storage areas and any target comprised of standard buildings. (12:29) A B-1B loaded with Mk 36 naval mines in a maritime role would be uniquely suited against targets which the Mk 36 was designed to attack, bottling up surface vessels and submarines by mining their shallow water ports. (20:441)

In employment of the naval mines, the B-1B could easily and rapidly sow mines in a strategic choke point there by "locking" vital supply ships in or out of strategic ports. If timeliness is as critical as most experts agree it will be in a European conflict/war, then there is no faster delivery vehicle in our inventory than the B-1B and it can deliver over half again as many mines as the B-52.(See figure on page 10) It is also more likely the B-1B, because of its unique "stealthiness", would survive getting into and out of an area such as the Baltic Sea on a mine-laying mission versus the larger and slower B-52.

As for delivering Mk 82 GP bombs, it is highly questionable the B-1B would be employed in direct overflight of what, most likely, would be a highly defended target. If the aircraft could deliver a greater lethality and the risk of attrition was lower, then the trade-offs approach acceptable levels. Consider, however, that for the cost of employing one 280 million dollar B-1B on a target, 240

Tomahawk cruise missiles could be employed on the same target. One B-1B carrying a payload of 84, 500 pound dumb bombs, delivers 42,000 pounds of explosive ordnance on target versus launching 240 cruise missiles having 1,000 pound conventional warheads, one gets 240,000 pounds of explosive ordnance on target.

Certainly the flaw here is in delivery schedule as you could get 42,000 pounds of ordnance on target with the single B-1B instantaneously versus missiles arriving in sequence. However, I want to illustrate that in employing the cruise missile, the delivery vehicle and crew can be kept out of certain risk. Of equal consideration is the fact that in employing multiple penetrating cruise missiles, the enemy's defense problems are increasingly complicated, and this can cause disruptions and confusion that will increase survivability of friendly fighters and other aircraft. This can act as a force multiplier since the more friendly assets available obviously increases the odds of greater enemy losses.

TECHNOLOGICAL IMPROVEMENTS

There are weapons and aircraft improvements that can be made in the near term which would increase the conventional lethality and thus, the likelihood of B-1B employment. These improvements are either presently available or could be available in the near future based on present technologies. In taking this approach, SAC would minimize cost and technological risk while significantly increasing its conventional capability.

B-1B IMPROVEMENTS – As discussed earlier, the current nuclear rotary launcher rotates much too slowly for conventional gravity releases. If these launchers were modified to rotate faster, this would allow for delivery of large munitions, such as a modified Mk 84, 2000 pound bomb. The cost of the launcher modification would be offset by the savings of a single rotary launcher now fulfilling a dual role for nuclear and conventional versus lengthy and expensive development of a separate conventional rack.

This expanded lethal capability would increase the conventional targets where the B-1B could be employed. Some of the additional targeting capabilities such as runways, aircraft, and aircraft shelters, troop and supply convoys, etc., I will discuss later when I address weapons improvements.

Another B-1B improvement is Mil Standard 1760 data bus. This is necessary to interface with new technology weapons to provide a common electronic interface between weapons and aircraft carrying them. All new generation weapons, conventional and nuclear, are required to use this protocol by DOD directive. (21:76) Therefore, it would be prudent to install the 1760 data bus to ensure B-1B compatibility with these future weapons.

The final B-1B improvement I will discuss falls under the general heading of sensors. The details of sensor technologies is far too complex to discuss here. Suffice to say, the updated sensors on the B-1B would provide increased passive capability to identify and classify potential threats and targets. For example, a B-1B equipped with Global Positioning System (GPS), a miniature receive terminal (MRT); improved passive, threat detection system; and smart or stand-off munitions could take off with little or no targeting data and passively receive all necessary data to precisely strike its target while enroute. This capability greatly enhances aircraft/aircrew survivability due to the fact there is no chance of being highlighted as would occur in any type of electronic transmission emanating from the aircraft. Navigational update would come via GPS, targeting data via the MRT, and threats to avoid from passive detection sensors.

WEAPONS IMPROVEMENTS – We cannot expect to fight a war in the 1990's with antiquated weapons. This is essentially what the B-1B is equipped with now when considering the Mk 82s were the main General Purpose bombs used in Vietnam. There are situations where gravity weapons can be most effective and the lowest cost alternative. One important area is runway busting where "Have

Void" Mk 84 play an important role. This program upgrades a portion of Mk 84s by strengthening the bomb casing and improving the fuze to insure these weapons do not break or skip on impact and penetrate hard targets such as runways or aircraft shelters for increased destructive capability of the weapon could be doubled by this simple and inexpensive upgrade. (22:86)

Another area of improvement would be a conventional cruise missile with a "zero CEP" (no circular error probably) for the long-range stand-off role.

Recently the Commission on Integrated Long-Term Strategy, chartered by the Secretary of the Defense to recommend armaments to serve our forces well into the next century reported: Current technology makes it possible to attack fixed targets at any range with accuracies within one to three meters and the Defense Department has been moving too slowly at making such potentialities real. (23:50)

Richard Perle, a former Assistant Secretary of Defense for International Security Policy, recently testified to Congress:

"Non-nuclear cruise missiles with previously unimaginable accuracy ... could enable the United States to replace nuclear with non-nuclear weapons for a class of important targets that can now be destroyed only with nuclear weapons. Such deployments would significantly raise the nuclear threshold and place even hardened targets at risk. This would create a formidable deterrent to conventional attack and diminish the need to rely on nuclear strikes to halt a conventional offensive early in a major war." (24:7)

The Intermediate Nuclear Forces(INF) Treaty, which bans ground-based conventional and nuclear missiles with ranges between 500 and 5000 kilometers, will result in a greatly expanded air force role in delivery of this weapon. Current capability for this mission resides with the aging B-52s.

Along with fundamental improvements in accuracies of weapon systems go improvements of warhead design/lethality. The key here

is pursuit of "brilliant munitions" and new employment of older technologies. Combining advances in fuzing and the use of heavy metals, such as tungsten and uranium, hard target ordnance can be assembled. This ordnance is meant to go after buried command-and-control bunkers encased by up to twenty feet of reinforced concrete and that today can be attacked only by nuclear weapons. (25:77)

Conventional cruise missiles need to be adaptable to a host of scenarios and various programmable and/or interchangeable ordnances packages available for effective employment. (26:3) Packages being considered range from the Navy's 1,000 pound AGM 12 Bullpup Warhead to rocket-assisted hard target penetrators as well as airfield-attack and smart anti-armour submunitions. Tentative plans call for completion of mission area analysis by the end of FY '90 and demonstration and validation phase in the following year. (25:78)

Interest has also been rekindled in FAE (Fuel Air Explosive) weapons following discovery of the Soviet intensive efforts in blast-enhancements in the past few years. (27:2) FAE weapons are very effective against selected targets such as mines/minefields, ammunition stacks, industrial buildings, trucks, radars, and personnel. The aerosol cloud has the capability to diffuse into tunnels as well as other incompletely sealed fortifications and detonate these structures from the inside out. However, this munition is ineffective against airfield runways and concrete bunkers fully sealed. (27:3) Worth consideration is the coupling of this ordnance with a cruise missile equipped with an earth-penetrating device, which is capable of penetrating sealed command and control bunkers and subsequently detonating; the effects merit further study. (25:78)

CHAPTER IV
CONCLUSIONS and RECOMMENDATIONS

CONCLUSIONS - In addressing shortfalls in the conventional warfare capabilities of the United States, the final report from The Commission On Integrated Long-Term Strategy drew the following conclusion: "To deter or respond to conventional aggression we need the capability for conventional counter-offensive operations deep into enemy territory." (23:2)

The B-1B today currently provides a measure of the heavy-payload, all weather, day/night conventional deep delivery capability no other U.S. weapon system can match. The B-1B can also operate from forward deployed bases removed from conflict or if required, respond quickly from CONUS bases to provide same day support anywhere in the world. The capability to rapidly project power at long ranges gives flexibility to respond effectively and quickly to conflict.

This flexibility is seriously limited by the B-1B's capability to deliver only two weapon types. Because of this current limitation coupled with the increasing threat, there is little or no conventional role in Europe for the B-1B now and most definitely in the future. This same assessment holds true for conventional employment for this aircraft against Third World countries with the more sophisticated Soviet defense systems, such as Syria, Libya, or Cuba. As long as the aircraft is restricted to overflight of the target area for conventional employment, then its role will remain limited to nonexistent due to the unacceptable risk of losing such a high value asset.

RECOMMENDATIONS - For the near term SAC needs to reassess the conventional role it has in mind for the B-1B. There are the few targets that have been addressed that are susceptible to MK 82s or Mk 36s and merit B-1B employment. It may sound simplistic, but is only when the gains outweigh the risk, will effective employment be accomplished.

There is a greater need for a "heavy kill" capability that could justify the use of the B-1B in an overflight mode. To achieve this the rotary launcher modification in conjunction with "Have Void" Mk 84 modification should be pursued. This would give the B-1B an unmatched runway/aircraft shelter C3I, busting capability. This is the only target required over flight that could justify the use of the B-1B.

Obviously the B-1B needs the Mil Standard 1760 data bus modification to be able to interface with any new generation weapons in development now and in the future.

Finally, conventional cruise missiles for the B-1B must be pursued aggressively. The aging B-52s will be in the inventory for a while longer, however, the B-1B will eventually replace it; so therefore any conventional cruise missiles developed should be designed primarily with the B-1B in mind.

In development of this cruise missile, consideration must be given to "brilliant munitions" and their capabilities that are available now and in the near term

We have the capacity and responsibility to effectively employ the weapon systems we are entrusted with. The key to effective employment of the B-1B is to modify aircraft systems and develop munitions that exploit the inherent advantages of this aircraft without exposing it to undue risk. SAC must pursue these objectives. The recommendations I have provided are in line with these objectives.

The B-1's potential non-nuclear applications ought to command as much attention in weighing the real value of the plane as its strategic attributes. Much like its predecessor the B-52, it is highly improbable that this plane will ever be used in nuclear anger against the Soviet Union. The nuclear stalemate that has deterred war between the superpowers for over a quarter century is likely to persist. In all likelihood there will only be the need to employ the B-1B in a conventional role. Will SAC be ready?

APPENDIX 1

CURRENT MISSIONS AND B-1B CHARACTERISTICS

MISSIONS: *Strategic* – penetrating bomber; standoff cruise missile carrier. *Conventional* – bombing, mine laying, maritime support, show of force.

ARMAMENT: AGM-69 short range attack missiles (SRAM, range of approx. 100 nm), air-launched cruise missiles (AGM-86B ALCMs, range of approx. 1500 nm) and Advanced Cruise Missiles (ACMs. range projected to be as great as 3500 nm), nuclear (B28, B61, B83) gravity and conventional (Mk 82) gravity bomb, and the (Mk 36) naval mine.

SPEED: Low-altitude (500 feet. and below) penetration – 0.85 Mach
High-altitude (42,000 feet) cruise – 0.72 Mach
Low-altitude withdrawal – 0.42 Mach

MAX TAKEOFF WEIGHT: 477,000 lb.

EMPTY WEIGHT: 192,000 lb.

MAX WEAPONS LOAD: 75,000 lb. Internal; 59,000 lb. External

MAX FUEL LOAD: 195,000 lb.

MAX RANGE UNREFUELED: 6,100 nm. Refueled by KC-135 or KC-10.

PROPULSION: Four General Electric F101-GE-102 turbofan engines developing 30,000lb. of thrust each.

NUMBER PRODUCED: 100; there have been three aircraft losses reducing this number to 97 remaining.

COST: Approximately $220 million each in constant 1981 dollars and not to include enhancements or modifications from baseline.

PROBLEM AREAS: The most pressing problem is the Electronic Counter Measures (ECM) suite, ALQ-161, does not meet contractual capability and is a "incurably flawed" design. (9:1) SAC is presently trying to resolve a work around solution with the contractor that will give partial capability but the cost of achieving design specifications is recognized as being cost prohibitive. The conventional weapons racks have just failed to be certified due to fractures in the complicated swing arm assembly. There is no estimate of the delay this will impose in certification or the cost of the fix. (13)

APPENDIX 2

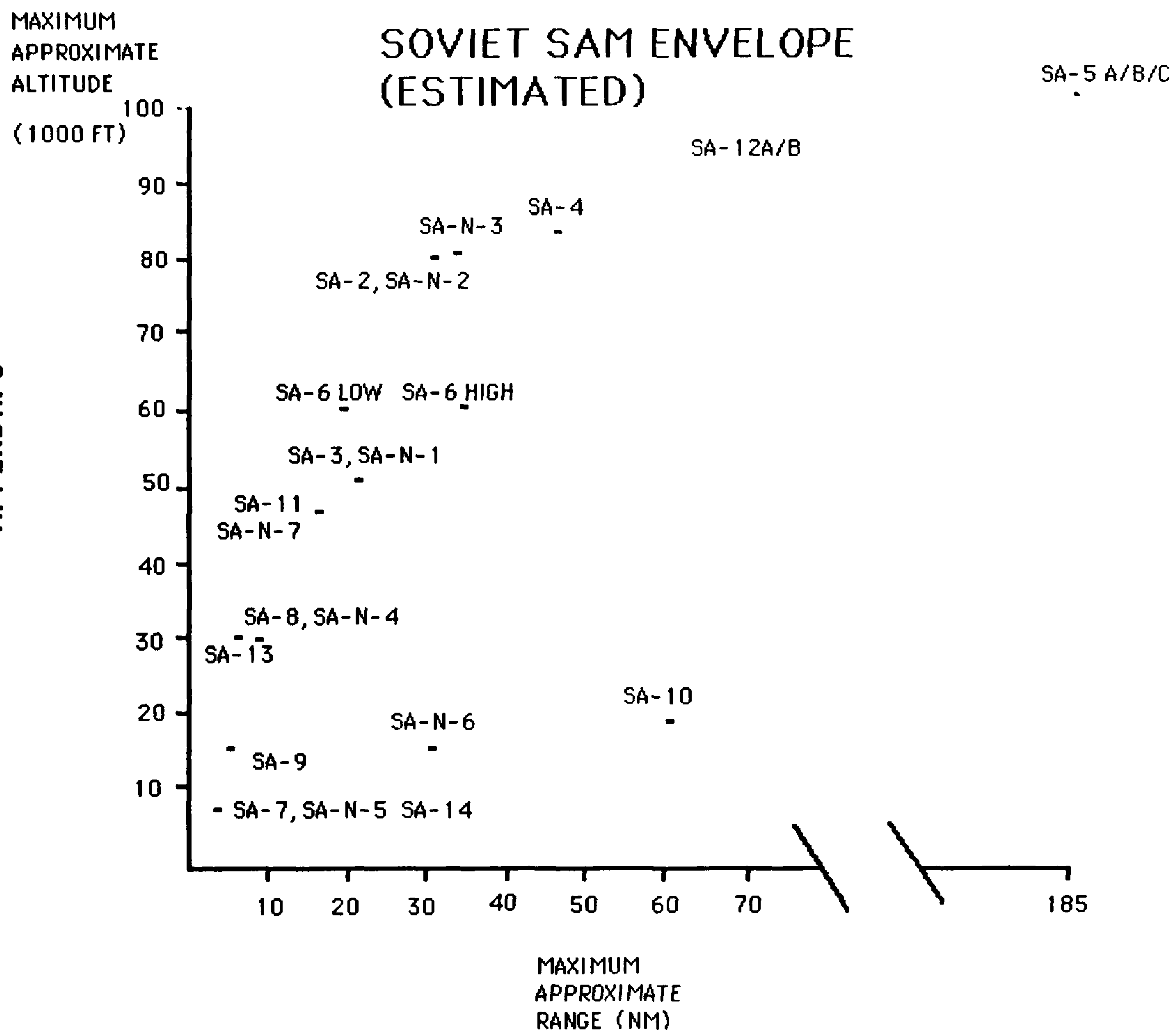
SOVIET SURFACE-TO-AIR MISSILES (SAMS)

#	DESIGNATION	NATO NAME	MACH	MOBILE/FIXED	ALT IN FEET	RANGE	REMARKS
1	SA-1	GUILD	- -	FIXED/SHIP	MEDIUM	31 NM	Antique/Deleting
2	SA-2	GUIDELINE	3.5	FIXED/SHIP	1600 - 82000	31	Many Variants
3	SA-3	GOA	2.0	MOBILE	300 - 60000	22	Similar to HAWK
4	SA-4A/B	GANEF	2.5	MOBILE	900-82000	43	Battlefield SAM
5	SA-5A/B/C	GAMMON	4.0	FIXED/SHIP	900-98000	186	Largest SAM
6	SA-6	GAINFUL	2.8	MOBILE	<900-60000	37	Widely exported
7	SA-7	GRAIL	1.5	MOBILE	5000	2.2	Improved to 6.0NM
8	SA-8	GECKO	2.5	MOBILE	LOW - 30000	9.2	Similar to ROLAND
9	SA-9	GASKIN	1.5	MOBILE	15000	5	On Amphibs
10	SA-10	GRUMBLE	6.0	FIX/MOBILE	<900-16500	60	ANTI-ALCM
11	SA-11	GADFLY	3.0	MOBILE	100-46000	18.6	Deployed w/ SA-6
12	SA-12A	GLADIATOR	3.0	MOBILE	LOW - 98000	62	Replaces SA-4
13	SA-X-12B	GIANT	3.0	MOBILE	LOW - 98000	62	SA-12A Variant
14	SA-13	GOPHER	2.0	MOBILE	165-32000	6.2	Replaces SA-9
15	SA-14	GREMLIN	--	MOBILE	> 5000	9.4	
16	SA-16	IGLA	--	MOBILE	> 5000	--	Replaces SA7&14
17	SA-N-1	GOA	--	SHIP	300 - 60000	22	SA-3 Variant
18	SA-N-2	GUIDELINE	3.5	SHIP	1600 - 82000	31	SA-2 Variant
19	SA-N-3	GOBLET	--	SHIP	82000	18.6	Improved to 34NM
20	SA-N-4	GECKO	2.5	SHIP	TO 30000	9.2	SA-8 Variant
21	SA-N-5	GRAIL	1.5	SHIP	LOW - 5000	6.0	SA-7 Variant
22	SA-N-6	GRUMBLE	>3.0	SHIP	LOW - 16500	34.5	ECCM Capable
23	SA-N-7	GADFLY	3.0	SHIP	100 - 46000	2 TO 30	SA-11 Variant
24	SA-NX-9	--	--	SHIP	--	--	

(REF 28: NUMEROUS PAGES)

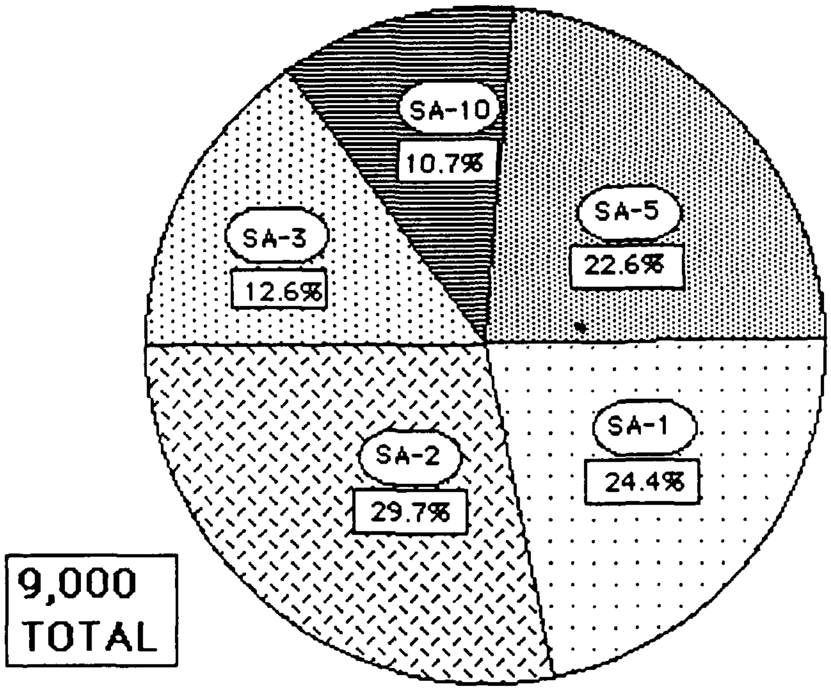
APPENDIX 3

SOVIET SAM ENVELOPE (ESTIMATED)

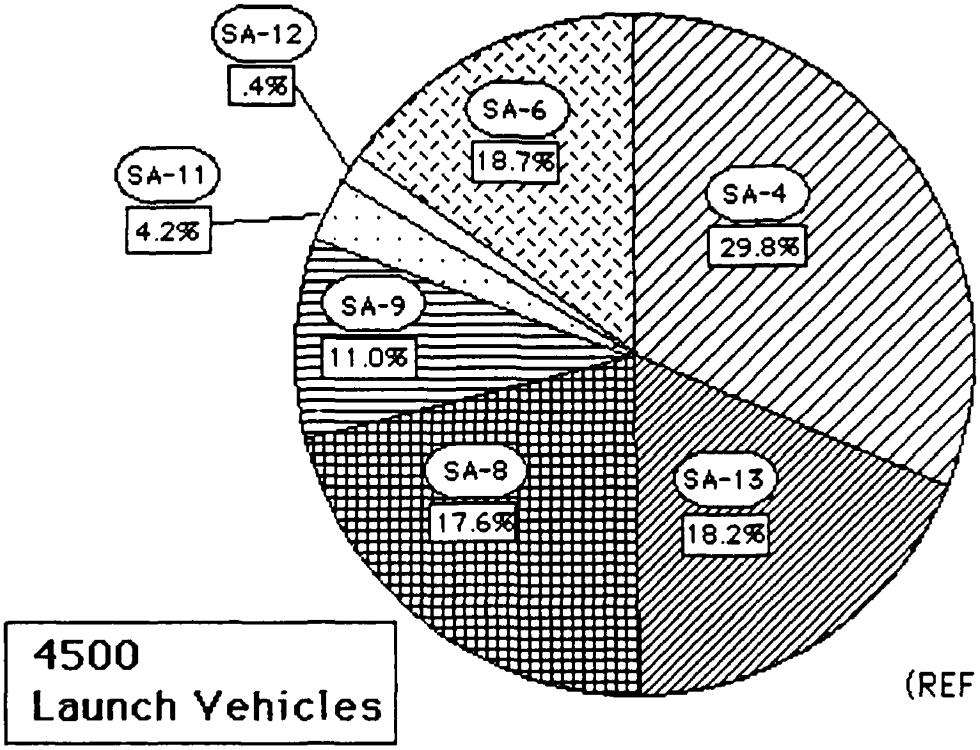


APPENDIX 4

STRATEGIC SAM LAUNCHERS 1987

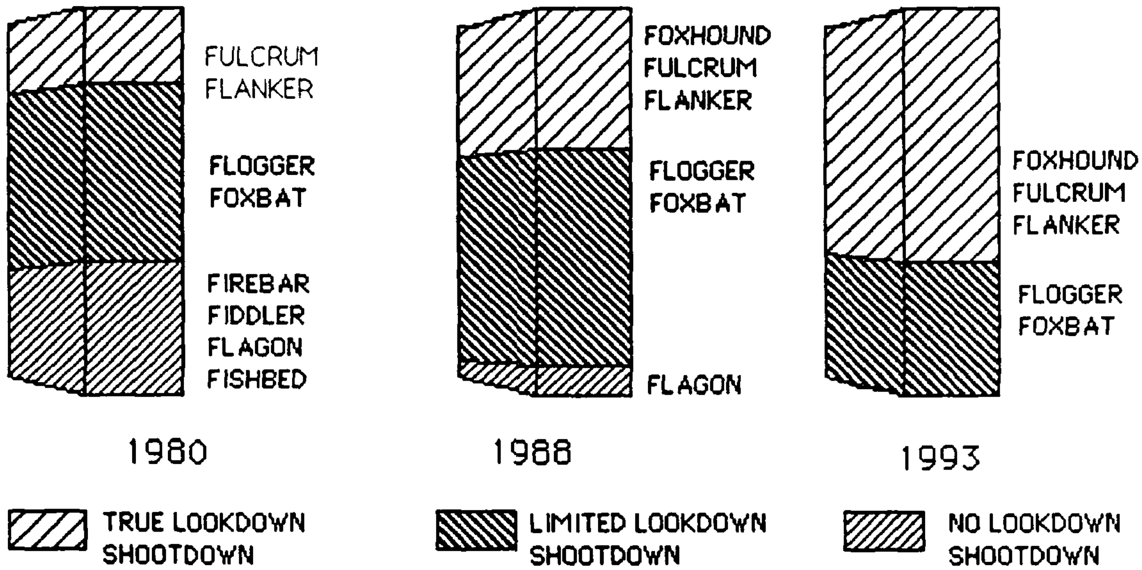


TACTICAL SAM LAUNCHERS 1987



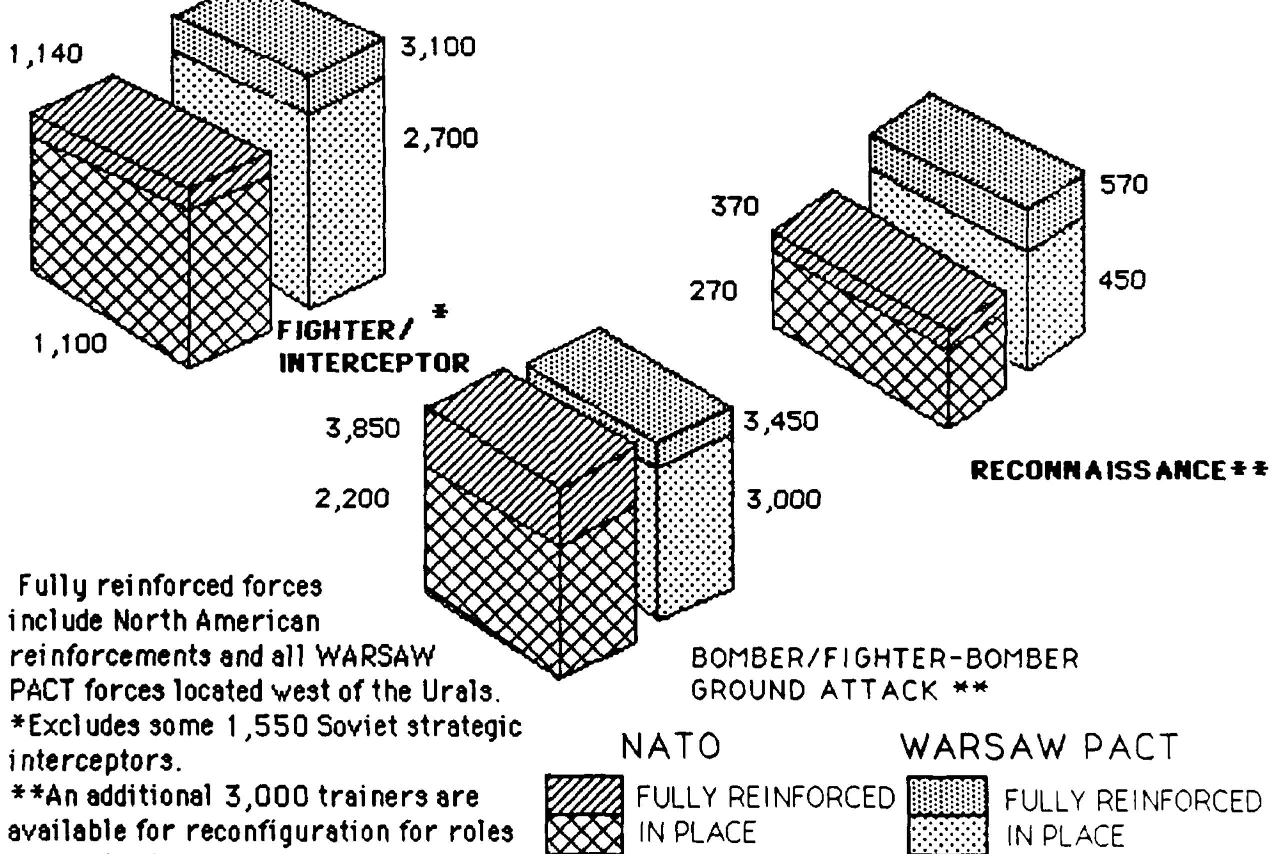
(REF 3:2,3)

SOVIET FIGHTER CAPABILITIES



NATO - WARSAW PACT

US Estimate of 1987 NATO DATA



Fully reinforced forces include North American reinforcements and all WARSAW PACT forces located west of the Urals.

*Excludes some 1,550 Soviet strategic interceptors.

**An additional 3,000 trainers are available for reconfiguration for roles as required.

(Source for all the above; 5:114,115)

APPENDIX 6

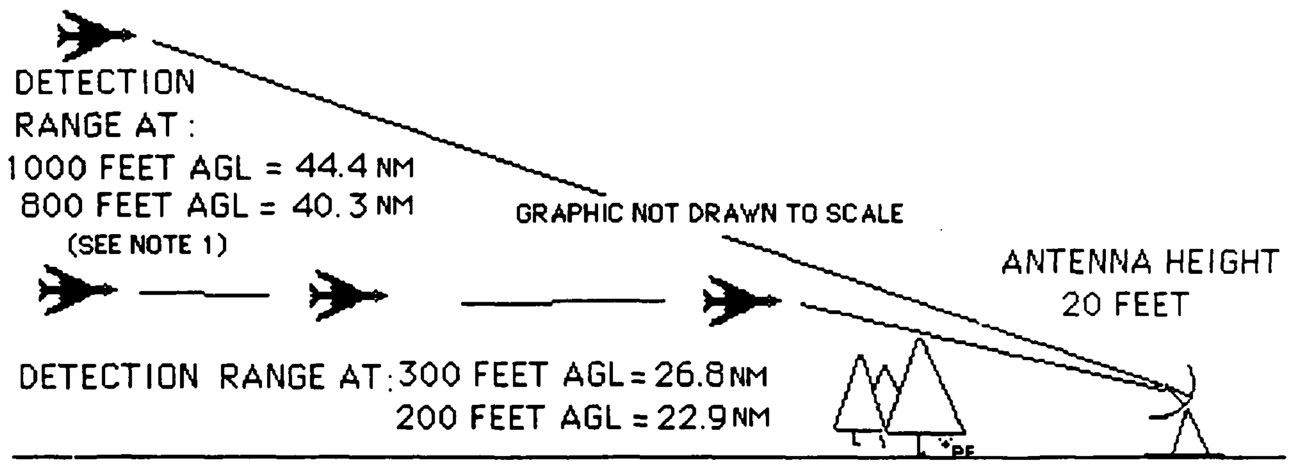
LINE-OF-SIGHT DETECTION GRAPHIC

	Ground speed:		Exposure time at:		
Dist	360 KTS	565KTS	360 KTS	565KTS	565 KTS
44.4	7m25s	4m44s	14m50s	9m28s	3m08s
40.3	6m40s	4m13s	13m20s	8m26s	2m52s
26.8	4m28s	2m50s	8m56s	5m40s	1m48s
22.9	3m50s	2m26s	7m40s	4m52s	1m36s

EXPOSURE TIME FOR THE <u>B-1B</u> BASED ON REDUCED RADAR CROSS SECTION. (SEE NOTE 3)

Dist=distance KTS=Knots m=minutes s=seconds

Exposure time= Twice time in ground speed column because it assumes worst case scenario where you would over fly the threat site. (SEE NOTE 2)



NOTE 1:

$$Rh = 1.23\left(\sqrt{h} + \sqrt{h_t}\right)$$ (REF29:161 fig 6.1)

Where Rh in nautical miles (NM) =line-of-sight range and h = height of radar receiver and h_t = height of target which in this case is an aircraft.

NOTE 2:

For example, if you were flying at 1000 feet and were traveling at 360 KTS your exposure time would equal 14 minutes 50 seconds where it would equal 4 minutes 52 seconds if you were flying at 200 feet and 565KTS.

NOTE 3:

Due to the reduced radar cross section, detection range can be reduced by a factor of 2/3 when comparing B-1B with B-52.

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